

**FRENCH RIVER BASIN
OXFORD, MASSACHUSETTS**

**ROBINSON POND DAM
MA 00670**

PHASE I INSPECTION REPORT NATIONAL DAM INSPECTION PROGRAM

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**DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154**

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ABSTRACT (Continue on reverse side if necessary and identify by block number) The dam is a dry-stone masonry and earth dam. It is about 850 ft. long with a maximum height of 15 ft. There are areas of concern which should be corrected to assure continued performance of the dam. It is considered to be in fair to poor condition.		

ROBINSON POND DAM

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OXFORD, MASSACHUSETTS

PHASE I INSPECTION REPORT
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PROGRAM

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PHASE I INSPECTION REPORT

BRIEF ASSESSMENT

Identification No.: MA00670

Name of Dam: Robinson Pond

Town: Oxford

County and State: Worcester County, Massachusetts

Stream: Tributary of French River

Date of Inspection: May 30, 1978

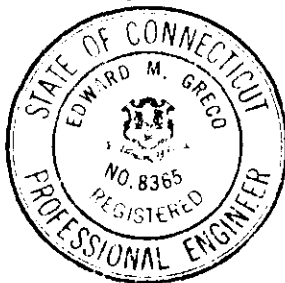
Robinson Dam is a dry-stone masonry and earth dam which was constructed around 1838. The dam has a maximum height of 15-feet and is approximately 850 feet long. It is comprised of a 500-foot long, 4-foot high earth dike section on the north and a 350-foot long, 4- to 15-foot high, dry-stone masonry and earth dam section on the south. These sections are separated by a 10-foot wide by 3.5-foot high mortared stone masonry spillway which discharges into a 7-foot high by 2-foot wide sluiceway. There are no plans, specifications, or computations available from the Owner, County, or State offices regarding the design, construction, or repairs of this dam.

Due to its age, Robinson Pond Dam was neither designed nor constructed by current approved state of art methods. Based upon the visual inspection at the site, the lack of engineering data available, and no operational or maintenance evidence, there are areas of concern which must be corrected to assure the continued performance of this dam. Generally the dam is considered to be in poor to fair condition. However, there are several visible signs of distress which indicate a potential hazard at this site: bulging of the stone wall on the downstream face of the dam, uncontrolled discharge through a blocked outlet conduit, slight-to-moderate seepage at the downstream toe of the dam, erosion on the upstream face of the dam, accumulation of debris in the spillway channel, and recent unauthorized filling of the dam crest.

Hydraulic analyses indicate that the existing spillway can discharge a flow of 126 cubic feet per second (cfs) at Elevation (El) 641.5 which is the dam crest. An inflow test flood of 1,250 cfs (one-half of the probable maximum flood) will overtop the main dam by about 1.0 feet. In the event of overtopping, complete failure of the dam could occur. Due to the potential for overtopping, it is recommended that a definite plan for surveillance and a warning system be developed for use during periods of unusually heavy rains and/or runoff.

It is recommended that the Owner remove the blockage in the outlet conduit so that the pond can be lowered, clear all debris from the spillway and remove all trees from the dam. Also, erosion of the upstream face should be repaired and riprap added to prevent continued deterioration of the dam. It is recommended that the Owner employ a qualified consultant to evaluate the dam stability and the seepage at the downstream toe. Further, because of inadequate spillway capacity, a more detailed investigation should be made of the hydraulic and hydrologic aspects of the site.

The above recommendations should be implemented within a period of 1 year after receipt of the Phase I Inspection Report. An alternative to these recommendations would be draining the reservoir and breaching or removing the dam.



A handwritten signature in cursive script, reading "Edward M. Greco".

Edward M. Greco, P.E.
Project Manager
Metcalf & Eddy, Inc.

Connecticut Registration
No. 08365

Approved by:

A handwritten signature in cursive script, reading "Stephen L. Bishop".

Stephen L. Bishop, P.E.
Vice President
Metcalf & Eddy, Inc.

Massachusetts Registration
No. 19703



This Phase I Inspection Report on Robinson Pond Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

CHARLES G. TIERSCH, Chairman
Chief, Foundation and Materials
Branch
Engineering Division

FRED J. RAVENS, Jr., Member
Chief, Design Branch
Engineering Division

SAUL C. COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in Recommended Guidelines for Safety Inspection of Dams, for a Phase I Investigation. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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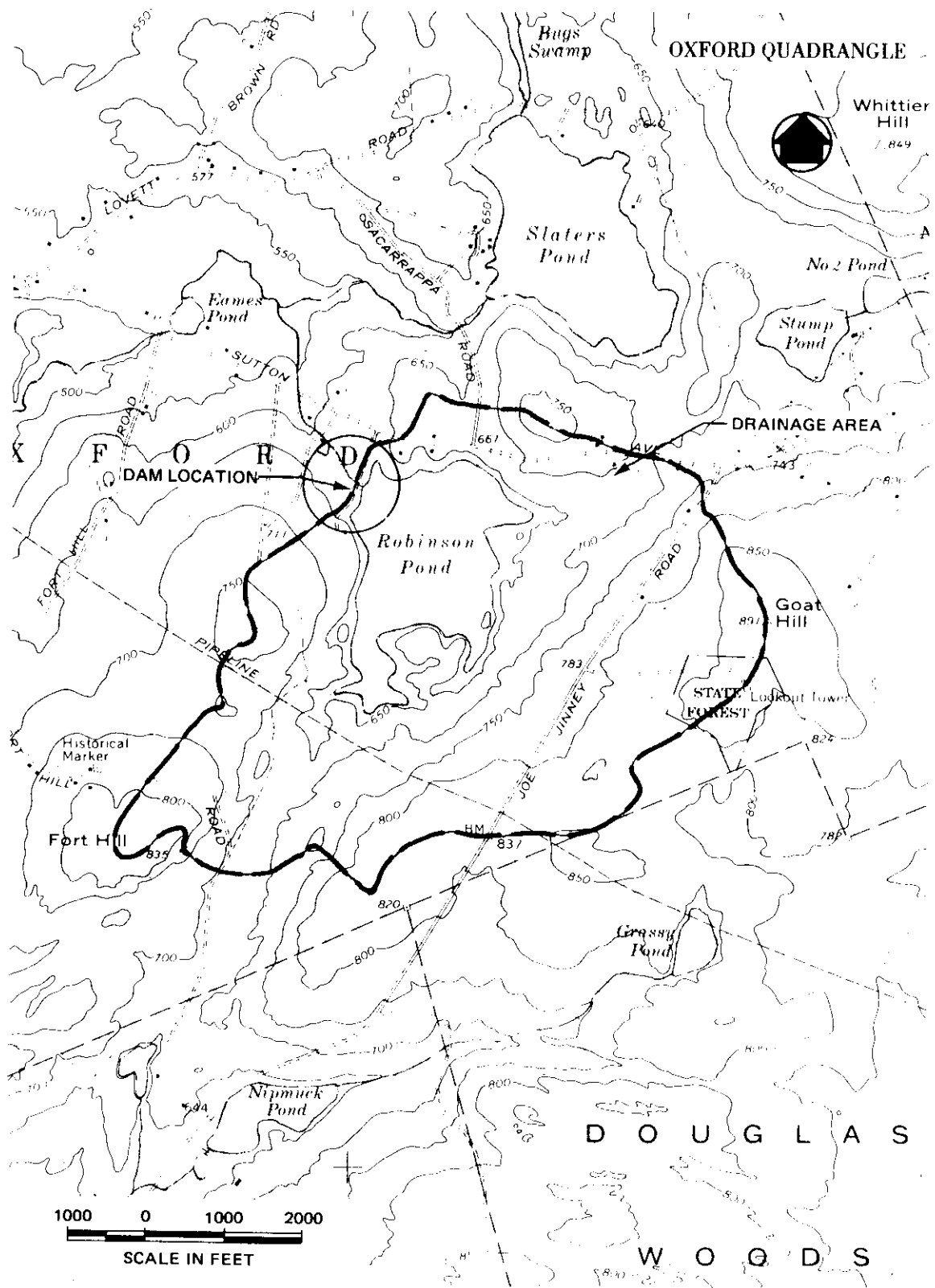
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**OVERVIEW
ROBINSON POND DAM
OXFORD, MASSACHUSETTS**



**VIEW LOOKING SOUTH OF UPSTREAM DAM AREA
SHOWING SPILLWAY TRAINING WALLS**

LOCATION AND DIRECTION OF
PHOTOGRAPHS SHOWN ON FIGURES
IN APPENDIX B



LOCATION MAP – ROBINSON POND DAM

NATIONAL DAM INSPECTION
PROGRAM

PHASE I INSPECTION REPORT

ROBINSON POND

SECTION 1

PROJECT INFORMATION

1.1 General

- a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Metcalf & Eddy, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Massachusetts. Authorization and notice to proceed was issued to Metcalf & Eddy, Inc. under a letter of May 3, 1978, from Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW 33-78-C-0306 has been assigned by the Corps of Engineers for this work.
- b. Purpose:
 - (1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.
 - (2) Encourage and assist the States to initiate quickly effective dam safety programs for non-Federal dams.
 - (3) To update, verify and complete the National Inventory of Dams.

1.2 Description of Project

- a. Location. The dam is located in the Town of Oxford, Worcester County, Massachusetts, on a tributary of the French River. See Location Map.
- b. Description of Dam and Appurtenances. Robinson Pond dam is a dry-stone masonry and earth-fill dam. It is comprised of a 500-foot long, 4-foot high earth dike section and a 350-foot long, 4- to 15-foot high dry-stone masonry and earth section (see Appendix B Figure B-1). The dike section that serves as the access road to the dam from Sutton Avenue is about 13-feet wide at the crest with upstream and downstream side slopes of 2:1 (horizontal to vertical). The maximum section of the main dam has a crest width of 15 feet, with upstream side slopes of 2:1. Its downstream side slopes are 4:1 from the edge of the road to the top of a vertical, 10-foot high dry-stone masonry wall which supports the downstream face (Figure B-1). The main dam is arched in the upstream direction. The main dam and dike section are separated by a 10-foot wide by 3.5-foot high, mortared stone masonry spillway which discharges into a 2-foot wide by 7-foot high sluiceway.

The only apparent outlet control for the dam is a 2-foot wide by 1-foot high, stone box conduit which extends from the upstream face of the dam to the spillway sluiceway. The invert of this conduit is 3.6 feet below the spillway crest. The gate for the outlet conduit has been removed and the conduit appears to be blocked by stones; however, significant flow from the debris-blocked outlet was still noted in the sluiceway end of the conduit.

- c. Size Classification. Robinson Pond Dam is classified in the "small" category since it has a maximum height of 15 feet and maximum storage capacity of 600 acre-feet.
- d. Hazard Classification. The Town of Oxford is located about 2 miles downstream from the dam, and between the Town and the dam there are no

known residential or commercial buildings. In the event of dam failure, few lives would be lost. Flooding of downstream areas would, however, cause appreciable property damage. Accordingly, the dam has been placed in the "significant" hazard category. This is in disagreement with the information reported by the State in their inspection report of June 20, 1974 wherein on page B-8 it was noted that a substantial risk to life and property was possible. This loss of life and property probably refers to the Town of Oxford. A flood wave resulting from dam failure would largely be dissipated before reaching the downtown area of Oxford.

- e. Ownership. The dam is presently owned by Kaltsas Realty, 2 Dracut Street, Worcester, Massachusetts 01603. Mr. George Kaltsas (617-755-7688) granted permission to enter the property and inspect the dam.
- f. Operator. There are no known operators of the dam. Mr. Kaltsas, Owner, indicated that he has not been to the dam site in over two years.
- g. Purpose of Dam. The dam was originally constructed as a storage dam for a sawmill located near the small pond 600 feet downstream from the dam. The mill later became a textile factory which burned down over 10 years ago, and since that time the pond has only been used for recreation by local residents. An apple orchard presently occupies the site of the former mill. According to Mr. Kaltsas, there are no present plans for the future use or development of the pond or the adjoining property.
- h. Design and Construction History. The dam was originally constructed by a Mr. Robinson in 1838 on what was then known as Menden Meadow. As mentioned, there are no plans, specifications, or computations available from the Owner, County, or State offices relative to the design, construction, or repairs of this dam; however, records at the Worcester County Engineer's office indicate that the embankment was widened at least 6 feet in 1939 and that

the spillway was rebuilt and widened in 1941. In 1974, maintenance work by Kaltsas Realty, Inc. consisted of clearing trees, brush, and debris from the spillway and dam. The sluice gate for the outlet conduit was removed at about the same time.

During this inspection of the dam, it was noted that gravel fill had recently been placed on top of the dam immediately south of the spillway (see Overview Photo). Conversations with local residents indicated this was done in April 1978. Mr. Kaltsas stated this work was done without his authorization or knowledge.

1. Normal Operational Procedure. There are no normal operational procedures at the dam. The only apparent outlet control for the dam is a 2-foot wide by 1-foot high stone conduit. As noted above, Kaltsas Realty, Inc. removed the sluice gate from this conduit to maintain the water level about 3.6 feet below the spillway crest. Since that time, and without authorization from Mr. Kaltsas, the conduit has been blocked to maintain the pond water surface at a higher elevation.

The spillway for Robinson Pond is ungated and flows are unrestricted though blockage is caused by existing debris.

1.3 Pertinent Data

- a. Drainage Area. The approximately 740-acre (1.16 square mile) drainage area above the dam consists of sparsely developed, heavily wooded, and moderately steep land. Discharge is to Eames Pond, about 4,000 feet downstream, which in turn flows into Lowes Pond, about 7,000 feet downstream. Subsequent flow is to the French River which is about 4 miles from Robinson Pond.
- b. Discharge at Dam Site. Normal discharge from the pond is by a stone box conduit. The conduit is approximately 1-foot high by 2-feet wide and has an invert at El 635.4 which leads to a 2-foot wide stone sluiceway. The conduit was at one time controlled at the pond inlet by

a wooden sluice gate which has since been removed.

The existing ungated spillway, consists of a stone paved and walled channel, 10-feet wide by 3.6-feet deep. The spillway channel slopes slightly for 28 feet from the crest and then discharges into a 2-foot wide by 7-foot deep sluiceway which intersects the channel which is in line with and receives flow from the outlet conduit.

The sluiceway is constructed of stone and descends rapidly in steps to an earthen channel about 20 feet from the spillway channel.

The spillway can discharge an estimated 126 cfs at El 641.5 which is the dam crest. An inflow test flood of 1,250 cfs (half of the probable maximum flood) will overtop the main dam by about 1.0 feet.

The maximum flood at the dam site is unknown; however, records at the Worcester County Engineer's office state that the dam was not overtopped during the 1955 floods.

- c. Elevation (feet above Mean Sea Level (MSL)). A benchmark elevation of 639 at the spillway crest was estimated from a U.S.G.S. topographical map.

- (1) Top dam - Main dam: 641.5 to 642.6
 - Dike section: 641.1 to 642.2
- (2) Maximum pool-design surcharge: 641.5
- (3) Full flood control pool: Not Applicable (N/A)
- (4) Recreation pool: 639
- (5) Spillway crest (ungated): 639
- (6) Upstream portal invert diversion tunnel: N/A
- (7) Stream bed at centerline of dam: 626.8

- (8) Maximum tailwater: None. (Swamp elevation at downstream toe - 626.8)

d. Reservoir

- (1) Length of maximum pool: 3,000 feet
- (2) Length of recreation pool: 3,000 feet
- (3) Length of flood control pool: N/A

e. Storage (acre feet)

- (1) Recreation pool: 600 (Approximate)
- (2) Flood control pool: N/A
- (3) Design surcharge: 250 at El 641.5
- (4) Top of dam: 850

f. Reservoir Surface (acres)

- *(1) Top dam: 96
- *(2) Maximum pool: 96
- (3) Flood-control pool: N/A
- (4) Recreation pool: 96
- (5) Spillway crest: 96

g. Dam

- (1) Type - Main dam: dry-stone masonry
earthfill
- Dike section: earth
- (2) Length - Main dam: 350 feet
- Dike section: 500 feet
- (3) Height - Main dam: 4 to 15 feet
- Dike section: 4 feet

*Based on the assumption that the surface area will not significantly increase with changes in reservoir elevation from 639 to 641.5.

- (4) Top width: Crest Access Road varies
from 13 to 15 feet
- (5) Side slopes - Main dam: Upstream 2:1;
downstream 4:1
to vertical
wall
- Dike section: 2:1
- (6) Zoning: Unknown
- (7) Impervious core: Unknown
- (8) Cutoff: Unknown
- (9) Grout curtain: Unknown

i. Spillway

- (1) Type: Broad crest
- (2) Length of weir: 10 feet
- (3) Crest elevation: 639 MSL (assumed
benchmark)
- (4) Gates: None
- (5) Upstream Channel: Flared training walls
- (6) Downstream Channel: 10-feet wide spillway
to 2-feet wide sluiceway
- (7) General: Spillway channel makes sharp 40
degree bend about 28 feet from pond and
drops into 2-foot wide, 7-foot deep
channel.

- j. Regulating Outlets. The only apparent reg-
ulating outlet is a 1-foot high by 2-foot wide
stone box conduit which, although presently
blocked by stones, is discharging to the
sluiceway. The sluice gate for this conduit
had been removed by the Owner.

SECTION 2

ENGINEERING DATA

- 2.1 General. There are no plans, specifications, or computations available from the Owner, State, or County offices relative to the design, construction, or repairs of this dam. The only data available for this evaluation were visual observations during inspection, review of previous inspection reports, and conversations with local residents, the Owner, and personnel from the State and County agencies.

The information available is such that the assessment of the condition of the dam must be based primarily on the visual inspection and the past operational performance of the structure.

We acknowledge the assistance and cooperation of personnel of the Massachusetts Department of Public Works: Messrs. Willis Regan and Raymond Rochford, and of the Massachusetts Department of Environmental Quality Engineering, Division of Waterways: Messrs. John J. Hannon and Joseph Iagallo.

Also, we acknowledge the cooperation and assistance of personnel from the Worcester County Engineer's Office: Messrs. John O'Toole, Joseph Brazauskas, and Mr. Wallace Lindquist - recently retired from county service.

In addition, we thank Mr. George Kaltsas, Kaltsas Realty, Inc. Owner of the dam, who allowed us to inspect the dam and provided us with information on the history and operating characteristics of the dam.

- 2.2 Construction Records. There are no detailed construction records available.
- 2.3 Operation Records. No operation records are available, and there is no daily record kept of pool elevation or rainfall at the dam site.
- 2.4 Evaluation of Data. The data acquired are considered adequate for this Phase I Inspection & Evaluation.

SECTION 3
VISUAL INSPECTION

3.1 Findings

- a. General. The Phase I inspection of the dam at Robinson Pond was performed on May 30, 1978. A copy of the inspection report is included in Appendix A. Periodic inspections of this dam by others have been made since 1924. A listing of these inspections is in Appendix B. Two inspections were made in 1974: on June 20, 1974 by representatives of the Massachusetts Department of Public Works, and on August 2, 1974 by personnel from the Corps of Engineers. Copies of their reports are included in Appendix B.
- b. Dam. The main dam is a dry-stone masonry and earthfill dam, and the dike section is an earth embankment. There is no information available on the zoning or core of either dam sections since they were constructed about 140 years ago. Several signs of distress are visible, the most severe being a bulge in the downstream stone wall at about 20 feet south of Point E as shown in Figure B-1 Dam Plan and Sections in Appendix B. A photograph of this bulge is shown in Appendix C. The bulge or dislodgment of stones was probably caused by the displacing action of large trees and frost.

Slight to moderate seepage was noted at the downstream toe of the dam at two locations. A flow of about 2 to 3 gpm (gallons per minute) was observed seeping beneath the downstream toe near Point D (refer to Figure B-1). Also a flow less than 1 gpm was noted at the downstream toe of the dam near Point F. The seepage at both locations was flowing clear at the time of inspection. In previous inspections, representatives of the Worcester County Engineer's office have noted seepage through the dam as early as 1934 although the location is not specified.

Slight erosion of the upstream face was observed at two locations on the main dam. Although the erosion does not appear severe at this time, it should be noted that there is no protecting riprap along the entire upstream face of the dam embankment.

Recent unauthorized filling of the dam crest, apparently to gain access over the dam, was noted in the area immediately south of the spillway. The elevation of the fill is not higher than the adjacent dam crest.

- c. Appurtenant Structures. The apparent outlet is a 1-foot high by 2-foot wide stone conduit. The inlet appears to be blocked by stone and the outlet covered with stones and debris. There is no sluice gate on the conduit. A clear flow of roughly about 2 cfs was measured in the sluiceway immediately downstream from the outlet of the stone conduit.

The spillway approach channel is partially restricted by debris, soil, and vegetation to a depth of about 3 to 6 inches. The spillway training walls are in fair to good condition. There is no evidence of wall movement or dislodgment of stones.

An access bridge across the spillway joins the main dam and dike section. It is constructed of four steel I-beams, plywood, and 2 x 10-inch planking and is 10-feet long by 11.2-feet wide. The bottom of the I-beams is 2.67 feet above the spillway crest. The bridge is in good condition.

- d. Reservoir Area. The reservoir and drainage area is sparsely populated and contains less than 20 residences. The drainage area is heavily wooded and slopes range from about 5 to 12 percent.
- e. Downstream Channel. The discharge from the spillway flows down an earth channel to a pond situated about 600 feet from the dam. (This pond is the former location of the saw-mill.) The slope of the channel is about 3 to 5 percent. For the first 300 feet, the

spillway channel is separated from the main stream bed by an earth dike that is approximately 10 to 12 feet high and has a 4- to 5-foot stone wall. After this, the spillway discharge flows into the main channel.

From the sawmill pond, the discharge flows to Eames Pond, Lowes Pond, and on to the French River.

- 3.2 Evaluation. The above findings indicate that the dam has several severe signs of distress that require attention. It is evident that the dam is not maintained and that deterioration will continue unless action is taken. Recommended measures to improve these conditions are stated in Section 7.

SECTION 4
OPERATION PROCEDURES

- 4.1 Procedures. There are no operational procedures at this dam.
- 4.2 Maintenance of Dam. The dam is not adequately maintained and the Owner states that he has not been to the dam site in over two years. Several large trees are growing on the dam. Unauthorized filling has recently occurred at the dam crest.
- 4.3 Maintenance of Operating Facilities. The outlet conduit for this dam is plugged; however, significant flow is evident in the sluiceway immediately downstream from the outlet of this conduit. The sluice gate and mechanism have been removed.
- 4.4 Description of Any Warning System in Effect. There are no warning systems in effect at this dam.
- 4.5 Evaluation. There are no operational, maintenance, or warning systems in effect at Robinson Pond Dam. This is extremely undesirable considering the dam's magnitude and the fact that it is in the "significant" hazard category. A program of operation and maintenance for this dam should be implemented as recommended in Section 7.

SECTION 5

HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

- a. Design Data. The Probable Maximum Flood (PMF) rate was determined to be 2,150 cfs per square mile. This calculation is based on the average drainage area slope of 5.9 percent, the pond-plus-swamp area to drainage area ratio of 14 percent, and the U.S. Army Corps of Engineers' guide curves for Maximum Probable Flood Peak Flow Rates (dated December 1977). Applying one-half the PMF to the 1.16 square miles of drainage area results in a calculated peak flood flow of 1,250 cfs (inflow) as the inflow test flood. By adjusting the inflow test flood for surcharge storage, the maximum discharge rate was established as 540 cfs, with a water surface at El 642.5.

Flow over the dam crest is predicted to be 330 cfs, while flow through the spillway (assuming the bridge had been washed away) would be 210 cfs. The maximum head on the dam would be 1.0 feet with a discharge of 2.55 cfs per foot of width. Flow at critical depth would be at 0.6-foot depth with a velocity of 4.2 feet per second.

Hydraulic analyses indicate that the existing spillway can discharge a flow of 126 cfs at water surface El 641.5, which is the dam crest.

- b. Experience Data. Hydraulic records are not generally available for this dam. However, in an inspection report by personnel from the Worcester County Engineer's office, dated December 12, 1955, it was noted that the dam was not overtopped in the 1955 floods.
- c. Visual Observations. The spillway consists of a 10-foot wide by 3.5-foot high, mortared stone masonry spillway which discharges into a 2-foot wide by 7-foot high sluiceway. The length of the spillway from the spillway crest to the sluiceway is about 28 feet. The sluiceway is

oriented approximately 40 degrees from the direction of flow in the spillway.

During high discharges, it is anticipated that momentum will carry spillway flow across the angled sluiceway where the flow will meet a rock and earth wall that is about a foot higher than the spillway channel. High spillway flows may overtop the wall and continue overland. This configuration will cause a backwater effect and reduce the discharge capability of the spillway during high flows.

- d. Overtopping Potential. Overtopping of the dam is expected under the test flood of 1,250 cfs (inflow); as noted previously, however, the only available records on overtopping indicate that the dam was not overtopped during the 1955 floods. In the event of overtopping, complete failure of the dam could occur. A flood wave resulting from dam failure would be dissipated, causing appreciable property damage but minimal loss of life.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

- a. Visual Observations. The evaluation of the structural stability of Robinson Pond Dam is based on the visual inspection on May 30, 1978. As discussed in Section 3, Visual Inspection, there were several visible signs of distress.

Based on these observations, Robinson Pond Dam is a potential hazard. Static stability conditions are unsatisfactory and conventional factors of safety do not exist.

It is recommended that a more detailed investigation be initiated to evaluate the bulging of the stone wall on the downstream face of the dam and the seepage at the downstream toe of the dam.

- b. Design and Construction Data. Discussions with the Owner, County, and State personnel indicate that there are no plans, specifications, or computations relative to the design, construction, or repairs of this dam. Furthermore, information on the type, shear strength, and permeability of the soil and/or rock materials of the dam embankment does not appear to exist.

It was learned that this dam was built in 1838, probably of local soil or rock materials. There is no data, however, on the type of the impervious core wall. Many dams built in the 1800's in Worcester County had a timber core trench with puddled clay. An impervious cutoff was probably used at this site since the natural soils are relatively pervious. These clay-timber core walls will generally last an indefinite period provided the timber is continuously saturated. In the event that the reservoir or pond level is substantially lowered for a period greater than three months, the timber will rot and cause the dam to leak.

At some time in the past, the water surface elevation may have been lower or the pond may have been drained, either of which could explain the present leakage in the dam.

- c. Operating Records. There is no evidence of instrumentation of any type in Robinson Pond Dam, and there is nothing to indicate that any instrumentation was ever installed in this dam. The performance of this dam under prior loading can only be inferred by physical evidence at the site.
- d. Post-Construction Changes. There are no as-built drawings for Robinson Pond Dam. Available records indicate that the embankment was widened at least 6 feet in 1939 and that the spillway was rebuilt and widened in 1941. In 1974, maintenance work consisted of clearing trees, brush, and debris from the spillway and dam. The sluice gate for the outlet conduit was also removed at about the same time.

Recent unauthorized work at the dam site consists of gravel fill being placed on the crest of the dam in April 1978.

- e. Seismic Stability. This dam is located in Seismic Zone 2. Since static stability conditions are unsatisfactory, the dam is particularly vulnerable in the event of an earthquake.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment

- a. Condition. Due to its age, Robinson Pond Dam was neither designed nor constructed according to the current approved state of art methods. Based upon the visual inspection at the site, the lack of engineering data available, and no operational or maintenance evidence, there are areas of concern which must be corrected to assure the continued performance of this dam. Generally, the dam is considered to be in poor to fair condition. However, there were several signs of distress observed at the site: bulging of the stone wall on the downstream face of the dam, uncontrolled discharge through a blocked outlet conduit, slight to moderate seepage at the downstream toe of the dam, erosion on the upstream face of the dam, accumulation of debris in the spillway channel, and recent unauthorized filling of the dam crest.

Hydraulic analyses indicate that the existing spillway can discharge a flow of 126 cfs at El 641.5 which is the dam crest. An inflow test flood of 1,250 cfs (half of the probable maximum flood) will overtop the main dam by about 1.0 feet. Since previous records at this site indicate the dam was not overtopped in the 1955 floods, it is unlikely that this is a serious potential hazard. However, future development in the watershed may increase the rate of runoff and alter this conclusion.

- b. Adequacy of Information. The information available is such that the assessment of the condition of the dam must be based primarily on the visual inspection and the past operational performance of the structure.
- c. Urgency. The recommendations outlined below should be implemented within 1 year after receipt of the Phase I Inspection Report.

- d. Need for Additional Information. Additional investigations to further assess the adequacy of the dam and appurtenant structures are outlined below in 7.2 Recommendations.

7.2 Recommendations. In view of the concerns on the continued performance of this dam, it is recommended that the Owner employ a qualified consultant to:

- a. evaluate the dam stability and the seepage at the downstream toe;
- b. conduct a more detailed hydraulic and hydrologic investigation at the site.

The recommendations on repairs and maintenance procedures are stated below under 7.3 Remedial Measures.

7.3 Remedial Measures

- a. Alternatives. An alternative to the recommendations above and the maintenance procedures itemized below would be draining the reservoir and breaching or removing the dam.
- b. Operation and Maintenance Procedures. The dam and appurtenant structures are not adequately maintained. It is recommended that the Owner accomplish the following items:
 - (1) remove the blockage in the outlet conduit so that the pond can be lowered
 - (2) remove all trees from the dam
 - (3) clear all debris from the spillway
 - (4) repair erosion on the upstream face
 - (5) install riprap on the upstream face of the dam
 - (6) institute a definite plan for surveillance and a warning system during periods of unusually heavy rains and/or runoff

- (7) implement a systematic program of inspection and maintenance. As a minimum, the inspection program should consist of a monthly inspection of the dam and appurtenances and supplemented by additional inspections during and after severe storms. All repairs and maintenance should be undertaken in accordance with all applicable State regulations.

APPENDIX A

	<u>Page</u>
Periodic Inspection Checklist	A-1

PERIODIC INSPECTION

PARTY ORGANIZATION Metcalf & Eddy, Inc.

PROJECT Robinson Pond

DATE 5/30/78

TIME 8:00AM → 5:00PM

WEATHER Sunny - 85°F

W.S. ELEV. 636.9* U.S. N.A. D.N.S.

*assumed benchmark EI 639 at
the spillway crest from USGS
topographic quadrangle

PARTY:

- | | |
|-------------------------|-----------|
| 1. <u>Ed Greco</u> | 6. _____ |
| 2. <u>Carol Sweet</u> | 7. _____ |
| 3. <u>Susan Pierce</u> | 8. _____ |
| 4. <u>Lyle Branagan</u> | 9. _____ |
| 5. _____ | 10. _____ |

PROJECT FEATURE	INSPECTED BY	REMARKS
1. <u>Dam</u>	<u>Ed Greco</u>	
2. <u>Spillway</u>	<u>Lyle Branagan</u>	
3. _____		
4. _____		
5. _____		
6. _____		
7. _____		
8. _____		
9. _____		
10. _____		

PERIODIC INSPECTION CHECK LIST

PROJECT Robinson Pond DATE 5/30/78
 PROJECT FEATURE Dam Site NAME Ed Greco
 DISCIPLINE Geotechnical NAME _____

AREA EVALUATED	CONDITIONS
<u>DAM EMBANKMENT</u>	
Crest Elevation	<i>varies from 642.6 to 641.5</i>
Current Pool Elevation	<i>638.9</i>
Maximum Impoundment to Date	<i>unknown</i>
Surface Cracks	<i>none visible but dam crest recently filled</i>
Pavement Condition	<i>none</i>
Movement or Settlement of Crest	<i>area recently filled</i>
Lateral Movement	<i>downstream stone wall not vertical - bulge at station E + 20'</i>
Vertical Alignment	<i>irregular - settlement at bulge</i>
Horizontal Alignment	<i>stone wall - earth - arched</i>
Condition at Abutment and at Concrete Structures	<i>seepage at left abutment</i>
Indications of Movement of Structural Items on Slopes	<i>bulge at station E + 20'</i>
Trespassing on Slopes	<i>chipmunk holes at station E + 60' D.S.</i>
Sloughing or Erosion of Slopes or Abutments	<i>slight erosion - upstream face</i>
Rock Slope Protection - Riprap Failures	<i>dam - none to few stones visible dike - small stones - irregular</i>
Unusual Movement or Cracking at or near Toes	<i>none visible</i>
Unusual Embankment or Downstream Seepage	<i>at station D - 2 to 3 qpm</i>
Piping or Boils	<i>seeps appear clear</i>
Foundation Drainage Features	<i>unknown</i>
Toe Drains	<i>unknown</i>
Instrumentation System	<i>unknown</i>

PERIODIC INSPECTION CHECK LIST

PROJECT Robinson Pond
 PROJECT FEATURE Dike
 DISCIPLINE Geotechnical

DATE 5/30/78
 NAME Ed Greco
 NAME _____

AREA EVALUATED	CONDITION
<u>DIKE EMBANKMENT</u>	
Crest Elevation	<i>varies from 641.1 to 642.2</i>
Current Pool Elevation	<i>638.9</i>
Maximum Impoundment to Date	<i>unknown</i>
Surface Cracks	<i>none</i>
Pavement Condition	<i>none</i>
Movement or Settlement of Crest	<i>dip at 300'-450' north of spillway (crest elevation 641.4 - 641.1)</i>
Lateral Movement	<i>none apparent</i>
Vertical Alignment	<i>dip at 300'-450' north of spillway</i>
Horizontal Alignment	<i>unpaved access road - stone wall west side</i>
Condition at Abutment and at Concrete Structures	<i>not applicable</i>
Indications of Movement of Structural Items on Slopes	<i>none visible</i>
Trespassing on Slopes	<i>none visible</i>
Sloughing or Erosion of Slopes or Abutments	<i>brush + trees cover upstream slope</i>
Rock Slope Protection - Riprap Failures	<i>small stones 4"-6"</i>
Unusual Movement or Cracking at or near Toes	<i>none visible</i>
Unusual Embankment or Downstream Seepage	<i>swamp west of dike (see sketch)</i>
Piping or Boils	<i>none visible</i>
Foundation Drainage Features	<i>unknown</i>
Toe Drains	<i>unknown</i>
Instrumentation System	<i>unknown</i>

PERIODIC INSPECTION CHECK LIST

PROJECT Robinson Pond DATE 5/30/76
 PROJECT FEATURE Outlet works NAME Ed Greco
 DISCIPLINE Geotechnical NAME _____

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE</u>	
a. Approach Channel	<i>none</i>
Slope Conditions	<i>not applicable</i>
Bottom Conditions	<i>not applicable</i>
Rock Slides or Falls	<i>not applicable</i>
Log Boom	<i>not applicable</i>
Debris	<i>not applicable</i>
Condition of Concrete Lining	<i>not applicable</i>
Drains or Weep Holes	<i>not applicable</i>
b. Intake Structure	<i>remnants of gate structure</i>
Condition of Concrete	<i>minor cracking</i>
Stop Logs and Slots	<i>remnants</i>

PERIODIC INSPECTION CHECK LIST

PROJECT Robinson PondDATE 5/30/78PROJECT FEATURE Outlet WorksNAME Ed GrecoDISCIPLINE Geotechnical

NAME _____

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - TRANSITION AND CONDUIT</u>	
General Condition of Concrete	<i>fair</i>
Rust or Staining on Concrete	<i>not applicable</i>
Spalling	<i>not applicable</i>
Erosion or Cavitation	<i>not applicable</i>
Cracking	<i>not applicable</i>
Alignment of Monoliths	<i>not applicable</i>
Alignment of Joints	<i>not applicable</i>
Numbering of Monoliths	<i>not applicable</i>

*Intake and outlet of outlet conduit blocked by debris.
Discharge flowing at about 2 cfs.*

PERIODIC INSPECTION CHECK LIST

PROJECT Robinson Pond DATE 5/30/78
 PROJECT FEATURE Outlet works NAME Ed Greco
 DISCIPLINE Geotechnical NAME _____

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL</u>	
General Condition of Concrete	<i>fair</i>
Rust or Staining	<i>not applicable</i>
Spalling	<i>none visible</i>
Erosion or Cavitation	<i>not applicable</i>
Visible Reinforcing	<i>none</i>
Any Seepage or Efflorescence	<i>none visible other than from blocked outlet</i>
Condition at Joints	<i>not applicable</i>
Drain Holes	<i>none</i>
Channel	<i>small rocks and debris in sluiceway</i>
Loose Rock or Trees Over- hanging Channel	<i>few coarse stones</i>
Condition of Discharge Channel	<i>confined</i>

PERIODIC INSPECTION CHECK LIST

PROJECT Robinson Pond DATE 5/30/78
 PROJECT FEATURE Spillway NAME Ed Greco
 DISCIPLINE Geotechnical NAME _____

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS</u>	
a. Approach Channel	<i>flared training walls made of stone with concrete joints</i>
General Condition	<i>fair</i>
Loose Rock Overhanging Channel	<i>none</i>
Trees Overhanging Channel	<i>recently cleared</i>
Floor of Approach Channel	<i>brush debris at entrance (el=639.23)</i>
b. Weir and Training Walls	
General Condition of Concrete	<i>stone walls with concrete joints - fair to good condition</i>
Rust or Staining	<i>not applicable</i>
Spalling	<i>none</i>
Any Visible Reinforcing	<i>none</i>
Any Seepage or Efflorescence	<i>none</i>
Drain Holes	<i>none</i>
c. Discharge Channel	<i>discharge to outlet sluiceway</i>
General Condition	<i>restricted</i>
Loose Rock Overhanging Channel	<i>few</i>
Trees Overhanging Channel	<i>none</i>
Floor of Channel	<i>confined</i>
Other Obstructions	<i>2 large stone steps</i>

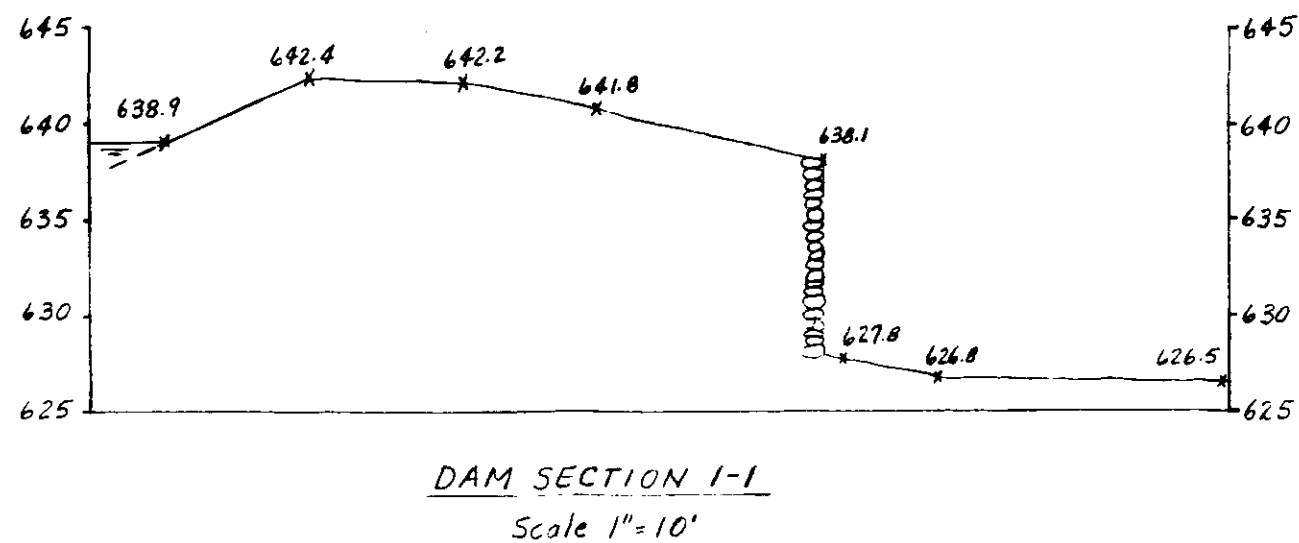
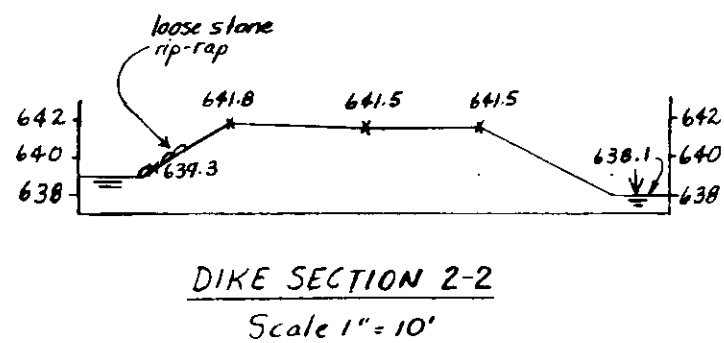
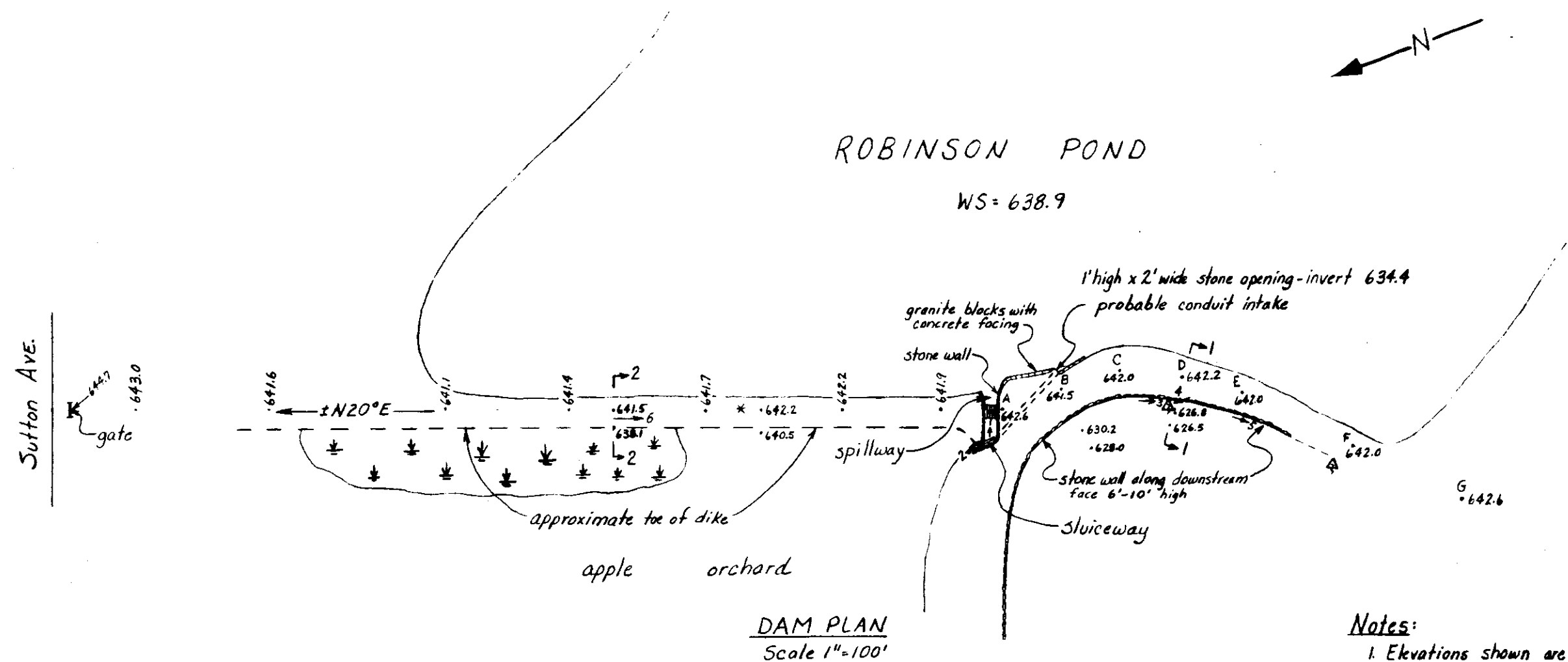
*Approach walls to spillway
and front face of dam*

*concrete facing cracked -
condition fair*

APPENDIX B

DAM PLAN AND PAST INSPECTION REPORTS

		<u>Page</u>
B-1	Dam Plan and Sections - Figure B-1	B-1
B-2	Previous Inspections (Partial Listing)	B-2
B-3	Inspection Report by Mass. Department of Public Works (July 24, 1974)	B-3
B-4	Inspection Report by U. S. Army Corps of Engineers (August 1, 1974)	B-8





- ## Notes:
1. Elevations shown are referenced to assumed benchmark elevation 639 (MSL) at spillway crest.
 2. Information shown based on field survey of May 30, 1978.
 3. Letters A through G shown on plan refer to survey control points.
 4.  denotes seepage point.
 5.  2 denotes direction of view and number of photograph given in Appendix C.

Figure B-1. DAM PLAN AND SECTIONS

TOWN OR CITY	Oxford	DECREE NO.	STORAGE POND	PLAN NO.		DAM NO.	276-16
LOCATION	Sutton Road - Robinson Pond	Notebook #12-P.6					
DESCRIPTION OF DAM		DESCRIPTION OF RESERVOIR & WATERSHED					
Type	Rubble Dry Masonry - Earth Fill.	Name of Main Stream	BRANCH OF MILL BROOK				
Length	800.±	" " any other Streams					
Height	14.	Length of Watershed	OWNER - KALTSAS REALTY CO. INC.				
Thickness top	13.	Width " "	% JAMES KALTSAS				
" bottom		Is Watershed Cultivated	HUGUENOT RD, OXFORD.				
Downstream Slope	Rubble Wall.	Percent in Forests					
Upstream	" 12:1 - Riprap	Steepness of Slope					
Length of Spillway	No Spillway except 6' wide raceway.	Kind of Soil					
Size of Gates	2x3 ✓	No. of Acres in Watershed	1044. = 1.2				
Location of Gates	300' from South.	" " " " Reservoir	100. = 1.6 Sq. Miles				
Flashboards used		Length of Reservoir					
Width Flashboards or Gates		Width " "					
Dam designed by		Max Flow Cu. Ft. per Sec.					
" constructed by		Head or Flashboards-Low Water	Draft = 7. Ft.				
Year constructed		" " " " -High "	22,000,000 Cu. Ft. Storage.				
GENERAL REMARKS		GENERAL REMARKS					
David N. Taft Kaltsas Realty Co. Oxford Robinson Pond		Inspected: Oct. 24, 1939 - L.O.M. Spofford-Taft					
50' from gate to raceway.		" : Dec. 10, 1940 - W.O. Lindquist.					
450' raceway North - Low Embankment.		" : Nov. 1, 1941 - L.O.M. Mr. Taft					
Inspected 1-31-24 - L.O.M. Farwell		" : Dec. 10, 1942 - L.H. Sarty					
" 3-13-26 - L.O.M.		" 2/14/72 - NICHOLSON & MURPHY					
Inspected 1/4/28 by L.O.M. & F.E.F.							
" 12-27-34 " "							
" 4-17-37 " K.M. Finlayson							
" 10-15-38 " L.H. Spofford							

PREVIOUS INSPECTIONS (PARTIAL LISTING)

COPY OF INSPECTION CARD ON FILE AT THE MASSACHUSETTS
DEPARTMENT OF PUBLIC WORKS, DISTRICT OFFICE, WORCESTER.

777
July 23, 1974

Miltons Realty Co.
Sussex Road
Oxford, Massachusetts

RE: Inspection-Plan 43-14-826-16
Oxford
Robinson's Pond Dam

Gentlemen:

On June 20, 1974, an engineer from the Massachusetts Department of Public Works inspected the above dam, owned by the Miltons Realty Co.

The inspection was made in accordance with Chapter 253 of the Massachusetts General Laws, as amended by Chapter 595 of the Acts of 1970 (Dam-Safety Act).

The results of the inspection were inconclusive because of the heavy brush at the dam; however, the following conditions were noted that require attention:

1. Remove the growth of brush and trees from the embankment of the dam so that a reconstruction could be made.
2. The inlet end of the sluiceway is buried or collapsed. The gate mechanism was missing.
3. Remove the growth and debris in the spillway. The clearing of the spillway requires immediate attention.

An early reply indicating that the area has been cleared is appreciated so that the reconstruction may be conducted. If we may be of assistance please do not hesitate to contact us. Your questions may be directed to Mr. Leo Andrade or Mr. John Fitzgerald, telephone 747-1177.

Very truly yours,

ACS
LEA
cc: Oxford Conservation Commission
J.J. Lyons
W. Regan

WILSON E. SPIN, P.E.
Associate Commissioner

B-3

DESCRIPTION OF DAM

DISTRICT 3

Designed by T. POWERS
6/20/74

Dam No. 3-14-226-16

City/Town OXFORD

Name of Dam ROBINSON POND DAM

Location: Topo Sheet No. 21 D

Provide 8½" x 11" in clear copy of topo map with location of Dam clearly indicated.

Year built: _____ Year/s of subsequent repairs _____

Purpose of Dam: Water Supply _____ Recreational ☒

Irrigation _____ Other _____

Drainage Area: 1.6 sq. mi. _____ acres

Normal Ponding Area: 100± acres; Ave. depth _____

Impoundment: 200 MILLION gals.; _____ acre ft.

No. and type of dwellings located adjacent to pond or reservoir

NONE i.e. summer homes, etc. _____

Dimensions of Dam: Length 900'± Max. Height 10'±

Slopes: Upstream Face 2:1

Downstream Face VERTICAL 2:1

Width across top 15'-40' AVE. 18'

Classification of Dam by Material:

Earth ☒ Conc. Masonry ☒ Stone Masonry ☒

Timber _____ Rockfill _____ Other _____

Description of present land usage downstream of dam:

100 % rural; _____ % urban.

Is there a storage area or flood plain downstream of dam which could accommodate the impoundment in the event of a complete dam failure? yes ☒ no _____

INSPECTION REPORT - DAMS AND RESERVOIRS

Location: ~~City~~/Town OXFORD Dam No. 3-14-226-16

Name of Dam ROBINSON'S POND DAM Inspected by F. POWERS
R. RIZKALLA

Date of Inspection 6/20/74

Owner/s: per: Assessors _____ Prev. Inspection ✓

Reg. of Deeds _____ Pers. Contact _____

1. KALTSAS REALTY CO. HUGENOT RD., OXFORD
Name _____ St. & No. _____ City/Town State Tel. No. _____

2. _____
Name _____ St. & No. _____ City/Town State Tel. No. _____

3. _____
Name _____ St. & No. _____ City/Town State Tel. No. _____

Caretaker (if any) e.g. superintendent, plant manager, appointed by absentee owner, appointed by multi owners.

Name: _____ St. & No.: _____

City/Town: _____ State: _____ Tel. No.: _____

No. of Pictures taken NONE

Degree of Hazard: (if dam should fail completely)*

1. Minor _____ 2. Moderate ✓

3. Severe _____ 4. Disastrous _____

* This rating may change as land use changes (future development)

Outlet Control: Automatic _____ Manual _____

Operative _____ yes; _____ No.

Comments: NO CONTROL VISIBLE

Upstream Face of Dam: Condition:

1. Good _____ 2. Minor Repairs ✓

3. Major Repairs _____ 4. Urgent Repairs _____

Comments: MINOR EROSION - SMALL & LARGE TREES, HEAVY BRUSH

Downstream Face of Dam:

Condition: 1. Good _____ 2. Minor Repairs ✓

3. Major Repairs _____ 4. Urgent Repairs _____

Comments: BULGING OF DRY STONE WALL NEAR S'LY END
BRUSH & TREESEmergency Spillway: NONE

Condition: 1. Good _____ 2. Minor Repairs _____

3. Major Repairs _____ 4. Urgent Repairs _____

Comments:

Water Level at time of inspection: 2 ft. above _____ below ✓top of dam _____ principal spillway ✓

other _____

Summary of Deficiencies Noted:

Growth (Trees and Brush) on Embankment HEAVY GROWTHAnimal Burrows and Washouts NONE VISIBLEDamage to slopes or top of dam MINOR SLOPE DAMAGE BOTH FACESCracked or Damaged Masonry CEM. CONC. WALL S'LY OF SPILLWAY SPALLS & CRACKSEvidence of Seepage NONE NOTEDEvidence of Piping NONE NOTEDErosion MINOR (AS NOTED ABOVE)Leaks NONE NOTEDTrash and/or debris impeding flow TRASH & DEBRIS IN SPILLWAY - LIVE GROWTH
RILL (NO FLOW AT TIME OF INSPECTION)Clogged or blocked spillway PARTIALLY (AS NOTED ABOVE)Other ✓

12. Remarks & Recommendations: (Fully Explain)

THE DENSITY OF GROWTH ON ALL PARTS OF THIS DAM, PARTICULARLY THE UPSTREAM FACE, MAKES INSPECTION VERY DIFFICULT. ANY LARGE & SMALL TREES SHOULD BE REMOVED AS SHOULD DENSE GROWTH OF BRUSH. THE LIVE GROWTH & DEBRIS IN SPILLWAY SHOULD BE REMOVED AS SOON AS POSSIBLE. THERE WAS A SMALL FLOW OF WATER VISIBLE IN THE DRAWDOWN ICEWAY AT THE TIME OF THE INSPECTION, BUT THE INLET IS BARRED OR COLLAPSED AND NO GATE MECHANISM WAS FOUND. AT PRESENT THE WATER LEVEL IS VERY LOW & THE LACK OF OUTLET CONTROL IS NOT A SERIOUS HAZARD. HOWEVER, DEFICIENCY SHOULD ALSO BE CORRECTED AT AN EARLY DATE.

13. Overall Condition:

1. Safe ☒
2. Minor repairs needed ☒
3. Conditionally safe - major repairs needed ☐
4. Unsafe ☐
5. Reservoir impoundment no longer exists (explain)
Recommend removal from inspection list ☐

DAM NO. 3-14-226-16

Risk to life and property in event of complete failure.

No. of people 250 ± .
No. of homes 50 ± .
No. of Businesses 10 ± .
No. of industries NONE . Type WATER, GAS
No. of utilities 5 . Type TEL, ELECT, SEWER
Railroads 1 (N.Y. N.H. + H.) .
Other dams 3-14-226-15 .
Other NONE KNOWN .

Attach Sketch of dam to this form showing section and plan on 8½" x 11" sheet.

How to locate: FROM INTERSECTION OF RT. 12 AND SUTTON AVE. IN OXFORD CTR. 1.6 MI. EASTERLY TO CHAIN LINK FENCE GATE ACROSS DIAT RD. ON SOUTHERLY SIDE OF SUTTON AVE. (Just BEFORE APPLE ORCHARD STAND ALSO ON SOUTHERLY SIDE.

ACKNOWLEDGMENTS

[illegible]

Gentlemen:

Members of my staff met with you on 1 August 1974 to inspect the three dams. Our investigation disclosed that these dams are all privately owned and that reconstruction or repair of the dams would only serve a need for recreation or aesthetic values and would not be utilized for flood control storage.

Recreational or aesthetic benefits, accruable to repair or reconstruction of the dams, would be considered secondary benefits and flood control benefits are insufficient to permit Corps of Engineers assistance under available authorities. Therefore, I must inform you that Federal assistance cannot be provided for restoration or reconstruction of the dams in Oxford and North Oxford. However, the following data on the condition of the dams and possible remedial action is included for your information. It is emphasized that our studies were preliminary and a private engineering firm should be contacted before proceeding with major repairs of the dams.

8 October 1974

ROBINSON POND DAM, OXFORD

A. PHYSICAL DATA

1. Pond

Area - 130 acres

Avg. Depth - 8 feet

Storage Cap. - 800 acre-feet (approximate)

2. Dam

Center Reach - 350 feet long and 9 feet high

Two sides reaches - each 400 feet long and 4 feet high

Type - Earth fill in side reaches. Earth fill with dry-wall stone masonry on downstream face of center reach.

3. Spillway

Centrally located, 10 feet wide x 3.5 feet high, is constructed of mortared stone masonry. Discharges into 7 feet high x 2 feet wide mortared stone masonry, sluiceway.

4. Sluice Gate

Sluice gate is buried, size undetermined.

B. CONDITIONS

1. Dam and spillway are completely overgrown with trees, brush and vines making a thorough inspection impossible.

2. The masonry wall has tilted outward and some stones have been dislodged due to the heavy tree growth along the top.

3. The sluice gate structure is completely buried and the gate stem and operating equipment are rotted away.

4. There was very little seepage observed at the toe of the dam. All discharge was through the 7 foot x 2 foot sluiceway.

3 October 1974

C. CONCLUSIONS AND RECOMMENDATIONS

1. This dam is structurally sound. However, the heavy growth of trees and brush should be removed and the stone wall on the downstream face repaired.

2. The sluice gates structure should be uncovered and repairs made as necessary to make the gate operational.

NEBPPL-P

8 October 1974

Conford Conservation Commission

The State of Massachusetts has primary jurisdiction over non-Federal dams. Therefore, you may wish to seek guidance from the Massachusetts Department of Public Works in this matter. Also, you should contact the Associate Commissioner, Mr. Malcolm E. Graf, 100 Nashua Street, Boston, Massachusetts 02114. I hope the foregoing information will be useful to you.

Sincerely yours,

JOHN H. MASON
Colonel, Corps of Engineers
Division Engineer

copy furnished:

Mr. Malcolm E. Graf
Associate Commissioner
Mass. Dept. of Public Works
100 Nashua Street
Boston, Mass. 02114

APPENDIX C
PHOTOGRAPHS



NO. 1 - VIEW OF SPILLWAY LOOKING EAST FROM SLUICEWAY



NO. 2 - VIEW OF SLUICEWAY LOOKING NORTHWEST



**NO. 3 - VIEW NORTH SHOWING WALL
AT DOWNSTREAM TOE AT STATION D**



**NO. 4 - VIEW SOUTH SHOWING CLOSEUP OF WALL
AT DOWNSTREAM TOE AT STATION D**



NO. 5 - VIEW OF BULGE AT STATION E-20 LOOKING SOUTH



**NO. 6 - VIEW OF DIKE LOOKING SOUTH
ABOUT 300 FEET NORTH OF SPILLWAY**

APPENDIX D
HYDROLOGIC AND HYDRAULIC
COMPUTATIONS

[Gen. Reference: "Open Channel Hydraulics" - Ven Te Chow]

(I) Broad Crested Spillway - $Q_s = CLH^{1.5}$ [Ref. pp. 360-362]

$$C = 3.27 + 0.4 \frac{H}{h} ; L = L' - 0.1NH$$

H = Physical Water Head on CREST (h_v not included)

h = Weir Height, L' = Measured Crest Length

Assumptions

For Floods or Peak Flows, $\frac{H}{h} \approx 0.5 \therefore C = 3.47$

$$L = 90\% L'$$

$$\therefore Q_s = 3.12 L' H^{3/2}$$



(II) Flow over Crest of Dam - $q_c = 3.475 \left[\frac{y}{y+h'} \right]^{1/2} (H')^{3/2}$ [Ref pp 52-3]

q_c = Disch. / ft. of width

$H' \neq h'$ as defined above; $y = h' + H'$

Assumptions

For Floods (flow over dam crest)

$$H' = \frac{1}{6} h' \text{ [note } h' \approx h + H \text{ in Item (I) above]}$$

$$\therefore y = \frac{7}{6} h' \neq \left[\frac{y}{y+h'} \right]^{1/2} = \left[\frac{7/6 h'}{13/6 h'} \right]^{1/2} = 0.734$$

$$\therefore \boxed{q_c = 2.55 (H')^{3/2}}$$

Apply to Crest in steps where levels are roughly const.

III Spillway Flow

$$L' = 10.25' , Q = 31.98 H^{3/2} \approx 32 H^{3/2}$$

Crest Elev. taken as 639.0

Assume Small Bridge is washed out at high flows.

Elev.	639.0	640.0	641.0	641.5	642.0	642.5	643.0	643.5
Calc Q (cfs)	0	32	90.5	126.5	166.3	209.5	256.0	305.4
Used Q (cfs)	0	32	90	126	166	210	256	305

IV Dam Crest Flow

Assume Northern Dike leads only to swamp or orchard with little significant discharge

Dam Crest Taken from Survey as.

$$70' @ \text{Elev. } 641.5 \therefore Q_{c1} = 178.5(H')^{3/2}$$

$$230' @ \text{Elev. } 642.0 \therefore Q_{c2} = 586.5(H')^{3/2}$$

V Summary of Discharge, Storage & Storage Function vs Elev.

Elev.	641.5	642.0	642.5	643.0	643.5	644.0	640.0	640.5	641.0
Q_{c1}	0	63	178.5	327.9	504.9	705.6			
Q_{c2}	0	0	207.4	586.5	1077.4	1658.9			
Q_c	0	63	386	914	1582	2365	0	0	0
$Q_{Tot.}$	126	229	596	1170	1887	-	32	59	90
S	3.9"	4.7"	5.4"	6.2"	7.0"	-	1.5"	2.3"	3.1"
F_{Tr}	-	<u>631</u>	<u>539</u>	434	332	-			
F_{100}	<u>85</u>	-	-	-	-	-	340	253	<u>170</u>

(VII) Inflow Test Flood & 100 yr Flood

Drainage Area - 1.16 mi^2

Pond Area - 0.15 mi^2

Swamp Area - 0.01 mi^2 (Approx)

Ratio $\frac{0.15 + 0.01}{1.16} = \underline{14\%}$

Ground Area - (Approx)

$20\% @ 1.9\% = 38$

$40\% @ 7.4\% = 296$

$20\% @ 5.8\% = 116$

$20\% @ 6.8\% = 136$

586 - Ave Slope 5.9%

A- Est. Max Prob. Flood Peak Flow Rate - $2150 \text{ cfs}/\text{mi}^2$

$\text{PMP } Q_{\max} = 1.16 (2150) = 2494 \text{ cfs}$

$\frac{1}{2} \text{ PMP } Q_{\max} : \underline{1250 \text{ cfs} = \text{Inflow Test Flood}}$

B- 100 yr. frequency flood -

Based on 6 hour rainfall = 4.7 inches, less 0.18 inches. rain times 6 hours of minimal infiltration

$Q_{100} = 2494 \left(\frac{4.7 - 1.1}{19 - 1.1} \right) = \underline{500 \text{ c.f.s. Inflow } Q_{100}}$

(VIII) Storage Functions

Inflow Test Flood: $Q_{\text{out}} = 1250 \left(1 - \frac{5}{9.5} \right) = 1250 - 131.65 = F_{75}$

Inflow $Q_{100} : Q_{100 \text{ out}} = 500 \left(1 - \frac{5}{4.7} \right) = 500 - 106.45 = F_{100}$

(IX) Outflows

(Taken from Discharge vs Elev Curve - Pg. D-3 & evaluation of F_{75} & F_{100} on Pg. D-2)

Outflows - $Q_{75} = 545 \text{ c.f.s. @ El. 642.45}$

$Q_{100} = 125 \text{ c.f.s. @ El. 641.40}$

(X) Crest Flow Evaluation

Max. Depth above crest: $642.45 - 641.5 = 0.95'$

Local Discharge: $q = 2.55(.95)^{1.5} = 2.36 \text{ cfs.}$ ✓

Critical Depth = $\left(\frac{q^2}{g}\right)^{1/3} = \underline{0.56 \text{ feet}}$

Critical Vel. = 4.2 fps. ✓

(XI) Max. Spillway Discharge w/ Full Pond (El. 641.5)

$Q = 126 \text{ c.f.s.}$ ✓

APPENDIX E
INVENTORY FORMS